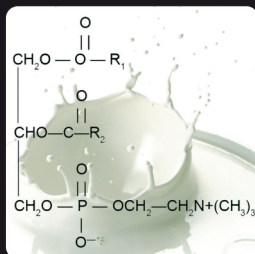


DAIRY TECHNOLOGY

VOLUME 1

Milk & Milk Processing



Shivashraya Singh

Dairy Technology

VOLUME – 1

Milk and Milk Processing

Shivashraya Singh

Former Joint Director-cum-Dean and Emeritus Scientist
National Dairy Research Institute
Karnal – 132 001, Haryana



NEW INDIA PUBLISHING AGENCY

New Delhi – 110 034



NEW INDIA PUBLISHING AGENCY

101, Vikas Surya Plaza, CU Block, LSC Market

Pitam Pura, New Delhi 110 034, India

Phone: + 91 (11)27 34 17 17 Fax: + 91(11) 27 34 16 16

Email: info@nipabooks.com

Web: www.nipabooks.com

Feedback at feedbacks@nipabooks.com

© Author, 2014

ISBN: 978-93-83305-08-7 (Volume -01)

ISBN: 978-93-83305-09-4 (Volume -02)

ISBN: 978-93-81450-99-4 (Set)

All rights reserved, no part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior written permission of the publisher or the copyright holder.

This book contains information obtained from authentic and highly regarded sources. Reasonable efforts have been made to publish reliable data and information, but the author/s, editor/s and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The author/s, editor/s and publisher have attempted to trace and acknowledge the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission and acknowledgements to publish in this form have not been taken. If any copyright material has not been acknowledged please write and let us know so we may rectify it, in subsequent reprints.

Trademark notice: Presentations, logos (the way they are written/presented), in this book are under the trademarks of the publisher and hence, if copied/resembled the copier will be prosecuted under the law.

Composed, Designed and Printed in India

Contents

<i>Foreword — Prof. (Dr.) A.K. Srivastava</i>	<i>vii</i>
<i>Foreword — Prof. V.B. Singh</i>	<i>ix</i>
<i>Preface</i>	<i>xi</i>

Part I: Physicochemical and Microbiological Characteristics of Milk

1. Definition and Composition of Milk	1
1.1. General Discussion of Milk.....	1
1.1.1. Definition of milk	2
1.1.2. Composition of milk	4
1.1.3. Colostrum	6
1.2. Cow Milk	9
1.2.1. Fat	13
1.2.2. Proteins	23
1.2.3. Lactose	32
1.2.4. Minerals and nutritional significance	39
1.2.5. Vitamins	47
References	48
1.3. Buffalo Milk	49
1.3.1. Fat	50
1.3.2. Proteins	50
1.3.3. Major minerals	51
References	56
1.4. Goat Milk	56
1.4.1. Fat	56

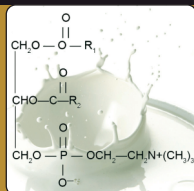
1.4.2. Protein	57
1.4.3. Minor proteins and enzymes	57
1.4.4. Minerals, salts and trace elements	58
References	60
1.5. Sheep Milk	60
1.5.1. Fat	61
1.5.2. Proteins	63
1.5.3. Lactose	64
1.5.4. Mineral elements	64
1.5.5. Vitamins	64
References	66
1.6. Yak Milk	66
1.6.1. Fat	67
1.6.2. Proteins	67
1.6.3. Minerals	68
1.6.4. Utilization	68
References	71
1.7. Camel Milk	72
References	74
1.8. Human Milk	75
1.8.1. Composition	76
1.8.2. Anti-infective properties	82
References	84
2. Nutritive Value of Milk	85
2.1. Nutritional Quality of Milk Proteins	86
2.2. Nutritional Benefits of Milk Fat	88
2.3. Minerals	89
2.4. Milk, A Rich Source of Vitamins	90
2.5. Therapeutic Properties and Extra-nutritional Role of Milk Constituents	91
2.6. Milk, A Cholesterol Lowering Food	94
References	95
3. Physical and Physicochemical Properties of Milk	97
References	108

4. Microbiology of Milk	109
4.1. Beneficial Microorganisms	110
4.2. Spoilage Microorganisms	114
4.3. Pathogenic Microorganisms	118
4.4. Microbial Population Dynamics in Milk	123
4.5. Effect of Processing on the Microbiology of Milk	125
4.6. Clean Milk Production	126
4.7. Contaminants in Milk	134
References	135

Part II. Processing and Preservation of Milk

5. Processing and Preservation of Milk	137
5.1. Market Milk	138
5.2. Pattern of Consumption	141
5.3. Types of Market Milk	142
5.4. Collection and Transportation of Milk	144
5.5. Types of Milk Collection Systems	145
5.6. Transportation of Raw Milk	147
5.7. Cooling of Raw Milk	148
5.8. Grading of Milk	151
5.9. Processing of Milk	159
5.9.1. Reception and storage of milk	159
5.9.2. Centrifugal operations	160
5.9.2.1. Filtration and clarification	161
5.9.2.2. Cream separation	164
5.9.2.3. Standardization	175
5.9.2.4. Bactofugation	178
5.9.2.5. Clarifixation	180
5.9.3. Heat treatment of milk	181
5.9.3.1. Pasteurization	182
5.9.3.2. Sterilization	192
5.9.3.3. Thermization	208
5.9.3.4. Forewarming	211
5.9.3.5. Condensing	212

5.9.4. Homogenization	213
References	218
6. Membrane and Alternate Technologies	219
6.1. Ultrafiltration	220
6.2. Reverse Osmosis	221
6.3. Microfiltration	224
6.4. Nanofiltration	225
6.5. Membrane Materials	230
6.6. Process Engineering Aspects	232
6.7. Electrodialysis	237
6.8. Pulsed Energy Technologies	246
6.9. Microwave Processing	250
6.10. Ultrasonication	252
6.11. Ionizing Radiation	253
References	255
7. Packaging and Distribution of Milk	257
7.1. Packaging Materials for Fluid Milk	259
7.2. Processes for Packaging Fluid Milk	262
7.3. Storage of Bulk Milk	263
7.4. Distribution of Processed Milk	264
References	276
8. Special Milks	277
8.1. Plain Special Milks	278
8.2. Flavoured Milks	280
8.3. Vegetable Solids-based Milks	283
8.4. Miscellaneous Milks	284
References	289



Readership: The book will serve not only as the textbook but also as a reference on Dairy Technology for students, teachers and a complete handbook for the entire dairy industry. This book will prove to be very useful not only to the academic community but also to the researchers, planners, plant managers and extension workers.

DAIRY TECHNOLOGY

Milk & Milk Processing

Processing of milk into various dairy foods, i.e. Dairy Technology is underpinned by disciplines such as chemistry and biochemistry, microbiology and process engineering. Strong emphasis on public health aspects and product quality demands that proper attention be given to the points in the production and processing chain where both pathogenic and spoilage microorganisms can be controlled effectively.

Keeping above points in view, a very comprehensive book has been written encompassing entire gamuts of chemical, physical and microbiological characteristics of milk, processing and preservation of milk.

The main objective of the book is to provide the latest information in a consolidated form at one point to meet the requirements of not only undergraduate and postgraduates students but also teachers and dairy professionals.

CONTENTS

Part I: Physicochemical and Microbiological Characteristics of Milk

- Definition and Composition of Milk
- Nutritive Value of Milk
- Physical and Physicochemical Properties of Milk
- Microbiology of Milk

Part II. Processing and Preservation of Milk

- Processing and Preservation of Milk
- Membrane and Alternate Technologies
- Packaging and Distribution of Milk
- Special Milks

Shivashraya Singh

Former Joint Director-cum-Dean and Emeritus Scientist, National Dairy Research Institute (NDRI), Karnal-132001, Haryana, India.

President of Dairy Technology Society of India located at the National Dairy Research Institute, Karnal - 132 001, Haryana, India

2014, 318 pages, figures, tables, index, 25cm



NEW INDIA PUBLISHING AGENCY

101, Vikas Surya Plaza, CU Block, L.S.C. Market
Pitam Pura, New Delhi-110 034, India
Tel. : +91(11) 27341717, Fax : +91(11) 27341616
E-mail : info@nipabooks.com
Web : www.nipabooks.com

ISBN 978-93-83305-08-7



9 789383 305087